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THE RELATIONS OF INFECTIOUS PROCESSES TO MENTAL DISEASE.[1]

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NEARLY a century ago Benjamin Rush, when considering the etiology of intellectual derangement, declared that gout, dropsy, consumption, pregnancy, and fevers of all kinds, produced madness by acting upon the brain in common with the whole body; and in one way or another, before his time and since, the subject assigned to me in the opening of this discussion has claimed the attention of the medical profession. It is one aspect of the old humoral doctrine of disease in general, to which we now recur, aided by experimental research and not simply by clinical and pathological observation.

Are special types of mental disease ever due directly to infection? Are the mental disorders of well-known infectious diseases always toxæmic, or are they sometimes the result of toxæmia and sometimes of anæmia or exhaustion? Are particular types of insanity due to the action of specific micro-organisms? In other words, has acute mania a bacillus which belongs to it, and to it alone; has melancholia its special pathogenetic microbe; is a special type of confusional insanity of microbic origin; has general paralysis of the insane a *bacterium sui generis?* These questions lead us naturally to consider inferences and conclusions drawn—1, from clinical and clinico-pathological observations; 2, from the analogies with nervous affections, not psychoses, but which are known or believed to be of microbic origin; 3, from the results of combined clinical, pathological, and bacteriological observations and investigations.

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[1] Read before the Congress of American Physicians and Surgeons, Washington, D. C., June 1, 1894.

Clinical and clinico-pathological observations have furnished us with a literature comparatively voluminous, but for the purposes of this discussion its teachings can be compressed into a small space. Two valuable contributions are a paper by Hurd[1] on "Post-febrile Insanity," and a report made to the Congress of French Alienists, in August, 1893, by Drs. Regis and Chevalier-Lavaure[2] on "Auto-Intoxication in Mental Diseases."

Regis and Chevalier-Lavaure refer to many cases of insanity in which neither heredity, organic disease of the nerve centres, nor any of the disturbances designated as neuroses can be assigned as a cause. They attribute the mental disorder in these cases to the excessive production or storing of products which are usually accumulated in much less amount or are eliminated. The blood, organic liquids, and especially the urine, undergo various modifications, their composition changing with the type of mental disease. They distinguish mental disorders as due—1, to infectious diseases; 2, to visceral disturbances; and 3, those associated with diathetic maladies. The second class includes mental disorders of hepatic and renal origin. They refer to the importance of studies of the toxicity of the intestinal contents, which recalls the important researches of Herter[3] on the relationship of the toxic products of intestinal putrefaction to epileptic seizures, presented in a paper read before the American Neurological Association in 1892. In the third group of insanities dependent upon auto-intoxication are included those occurring under the influence of such diatheses as arthritism, herpetism, diabetes, cancer, etc. Regis and Chevalier-Lavaure query whether or not general paralysis of the insane is not sometimes due to infection, and Parant, commenting on this suggestion, remarks that we sometimes see cases of mental confusion ending in a progressive paralytic failure, with delusions somewhat different, but with other symptoms of general paralysis, and that, therefore, while this opinion is not susceptible of any great generalization, it is nevertheless based upon actual facts.

With Hurd, I believe that we should recognize the fact that mental disorders described under the general head of confusional insanity—and I might add other types and sub-types—should be regarded as developing either from specific poisoning, from shock, or from anæmia and nervous exhaustion. Under the head of insanity from specific poisons, Hurd comprises "the delirium of fevers, both intermittent and exanthematous, of pneumonia, of uræmic poisoning, the transient insanity of influenza, the mental confusion of multiple neuritis, the delirium of iodoform, salicylic acid, and chronic alcoholic poisoning, and the delirium of puerperal fever. In this group of cases we have a poison acting directly upon the central or peripheral nervous system, producing an intoxication as shown by incoherence of ideas, confusion and a more or less rapid flow of thought. This poison may be of the nature of uræmia or of some toxic albumins—Welch has shown these to be produced in pneumonia and diphtheria, which possess a special toxicity to the nervous system—or an intoxicating drug which has a prolonged action. These poisons produce an active delirium which is generally self-limited and disappears when the exciting cause is removed and the period of convalescence established." While fully admitting the development of insanity from specific poisons, Hurd believes, however, that mistakes have arisen by confounding the confusion of febrile delirium with true post-febrile insanity. As the essential feature of delirium is mental confusion, and as delirium is often the product of toxæmia, well illustrated by drug-intoxications, this febrile delirium, at least, is toxic in origin; the insanity which follows may sometimes be due to persisting toxæmia, but in many cases it is the result of shock, anæmia, or nervous exhaustion.

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[1] Read before the Medical and Chirurgical Faculty of Maryland, April 28, 1892. Amer. Journ. of Insanity, July, 1892.

[2] Summarized by Parant in the American Journal of Insanity, January, 1894, vol. i, No. 3, p. 423.

[3] Herter: Journal of Nervous and Mental Disease, August, 1892, N. S., vol. xvii. p. 644.

Between 1834 and 1865, Chomel, Esquirol, Simon, Sauvet, Thore and Baillarger—cited by Hurd—described the mental disorders that accompany typhoid and other forms of fever, and among later writers Clouston,[1] Wood,[2] and Tuke and Woodhead,[3] have especially considered the subject. Febrile and post-febrile insanities have been shown by Nasse[4] and Spitzka[5] to be of not rare occurrence in children; the fevers, during or after which they develop most often these mental affections, being typhoid, scarlet fever, measles, rheumatism, and diphtheria. Clouston and Wood both regard post-febrile insanity as due to the anæmia and exhaustion which result from acute infectious disorders; and the latter has proposed to include under "confusional insanity" a special group of cases following infectious diseases, injuries, operations, and other causes. Korsakoff[6] regards the mental confusion, or confusional insanity, described by Clouston, Wood, Hurd, and others preceding them, as essentially a toxæmia, due to a special poison such as is developed in multiple neuritis, influenza, and other infectious disorders. According to Tuke and Woodhead, in the acute maniacal delirium which occasionally presents itself during the course of infective fevers, the two factors which should be taken into consideration are: first, the specific poison which appears to act directly on the nerve cells, giving rise to stimulation and impaired nutrition and consequent granular degeneration; and secondly, the high temperature during the persistence of which metabolic, or to speak more accurately catabolic, processes go on rapidly. In very acute cases extraordinary proliferation of connective-tissue cells round the vessels, and migration of leucocytes, take place—this being a condition commonly associated with the presence of micro-organisms, and well marked in acute exudative meningitis.

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[1] Clouston: Clinical Lectures on Mental Diseases, 1884, p. 416.

[2] Wood: University Medical Magazine, Dec. 1889, vol. ii. p. 117.

[3] Tuke and Woodhead: Tuke's Dictionary of Psychological Medicine, vol. ii. p. 911.

[4] Nasse: Allgemeine Zeitschrift für Psychiatrie, Berlin, 1870. p. 11.

[5] Spitzka: Keating's Cyclopædia of the Diseases of Children, vol. iv. p. 1046.

[6] Korsakoff: Allgemeine Zeitschrift für Psychiatrie, 1889, H. 4, p. 475.

Numerous isolated cases of acute delirium, acute mania, acute confusional insanity, so called, and other forms of acute mental disease, variously designated, occurring in connection with fevers like typhoid, have in recent years been reported in medical journals, but I can only here refer to a very few of these.

An argument in favor of the mental disorders of infectious diseases being due to toxæmia rather than to anæmia or exhaustion is furnished by the well-known fact that such diseases are sometimes ushered in by violent mental manifestations, or that such manifestations are the chief features of the disease, which pursues a course which is largely afebrile. I have seen and recorded several cases of typhoid fever which began or were preceded by an acute delirium, which closely simulated, and in some cases was diagnosticated as, common acute mania. A form of afebrile typhoid fever with severe cerebral symptoms has been recorded by Gerloczy:[1]

> A girl, nine years old, was taken sick with headache, chill, and fever, and soon became noisy and restless, and eleven days after the onset was comatose and screamed and tossed incessantly. Meningitis was suspected; the temperature never rose above 39° C. The treatment consisted of ice-cap and small doses of chloral at night. On the seventeenth day of the disease she became more quiet, so that an examination was possible, and this among other things showed a swollen spleen. From this time a gradual improvement took place. On the twenty-fifth day the child became conscious, and from the twentieth to the thirtieth numerous furuncles developed. Convalescence was interrupted by a rubeolous eruption without fever, but otherwise progressed favorably.

Chaslin[2] has described a form of mental disorder, usually acute, which is neither mania nor melancholia, which may be attributed to a rapid depression of the nerve centres from infection or auto-intoxication, and which he believed to be an intermediary form between functional psychoses and insanities with well-marked and profound lesions—although it assumes often the character of a true disease by the somatic phenomena. It is characterized by confusion of ideas, perception, and personal apperception. It may or may not be accompanied by hallucinations; motor agitations, depression, or stupor may be present. The disorder has a great analogy with the delirium of chronic intoxication, and has been designated under the name of "mental confusion." Cases similar to Chaslin's have been recorded by others. Liebermeister has attributed the great depression of temperature in such cases to the action of a virus—microbic or chemical—on the heat-regulating centres. The insanity of sunstroke is probably dependent upon a toxic condition, and by some is believed to be the result of catabolic changes produced by high temperature.[1]

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[1] Gerloczy: Deutsche med. Wochenschr., April 14, 1892, No. 15, p. 328.

[2] Chaslin: Annales Medico-psychologiques, Paris, 1892, p. 225. Cited in La Sémaine Médicale, Paris, August 10, 1892.

The somatic and psychical cerebral symptoms which accompany these infectious febrile disorders are not infrequently attributed to meningitis, or even encephalitis, and the patients are sometimes treated on the supposition that they are suffering from intracranial inflammatory affections, which are indeed occasionally present. These diagnoses are seldom corroborated by autopsies, and with our present lights the evidence—clinical and pathological—points rather to toxæmia.

Lloyd[2] and Tull[3] have reported cases of acute delirium without recognizable cause, leaning to the view that many such cases are infective in nature. The temperature in Tull's case—also seen by Lloyd—before death rose to 103.4° F. The autopsy revealed an uncertain incipient meningitis. Much negative pathological evidence in favor of the toxæmic origin of acute delirious seizures, like that afforded by the case of Lloyd and Tull, might be adduced, as many cases have been reported in which the autopsies were practically negative in their findings. My own experience has afforded several such cases, one of which is recorded in another paper.[4] I assisted at the autopsy of this case in the post-mortem room of the Philadelphia Hospital:

> The woman, a patient of Dr. E. P. Davis, three hours before she was brought to the hospital by the police patrol, had been delivered of a child. She was in a state of acute mania, and her limbs were extremely hyperæsthetic, with active contractures, and a scattered petechial eruption. The symptoms were suggestive of a cerebro-spinal meningitis with diffuse neuritis; but the autopsy showed clearly that no meningitis was present, and doubtless the case was one of toxæmia associated with anæmia.

The modifying influence which it is claimed is exerted by certain infectious diseases on mental disease is worthy of passing notice in view of the present ideas regarding toxines and anti-toxines. Mayberry[5] has referred especially to the influence of facial erysipelas in cases of melancholia; and Dinter, cited by Mayberry, has reported two cases of melancholia with erysipelas, one of which went on to recovery, and the other was improved only for a single day. In an epidemic of forty-four cases of facial erysipelas, Mayberry gives the results of the disease upon the mental condition as follows: "Three were cases of acute melancholia, one of whom went on to rapid recovery, one slowly improved from the time of the disease, and one remained unchanged; the two former were simple melancholia, and the latter melancholia agitata. Nine were cases of chronic melancholia, two of whom were temporarily improved; in one, a case of melancholia agitata, the delusions were more marked and the agitation greater; and six remained unchanged. One was a case of stuporous insanity, which seemed to begin to improve from the date of the sickness. Four were cases of acute mania, all of whom remained unchanged. Eleven were cases of chronic mania, one of whom had a lucid interval, while the other ten were not appreciably affected. Three were cases of paretic dementia, two of whom showed greater deterioration, and one remained unchanged. Two of epileptic mania remained unchanged. One of senile dementia became mentally weaker. Ten of terminal dementia showed no change." From these and similar observations on other cases, Mayberry was led to believe that erysipelas is more likely to favorably influence depressed cases of insanity of a comparatively short duration.

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[1] J. Batty Tuke and German Sims Woodhead: Tuke's Dict. Pysch. Med., 1892, vol. ii. p. 911.

[2] Lloyd: Medical News, Jan. 31, 1891, vol. lviii. p. 122.

[3] Tull: Ibid. p. 127.

[4] University Magazine, May, 1893, vol. v. p. 611.

[5] Mayberry: Journal of Nervous and Mental Diseases, May, 1894, N. S., vol. xix. p. 298.

To the consideration of the analogies of certain insanities with affections of the nervous system not psychoses nor insanities, but which are known or believed to be of microbic origin, I shall give brief space, as this aspect of the discussion has necessarily been largely treated of by my colleagues. In the affections which are now claimed as microbic, some with a strong showing of facts and arguments, and some with evidence as conclusive as can be furnished by medical science, are now included multiple neuritis, some forms of myelitis, tetanus, tetany, Landry's paralysis, chorea, epilepsy, disseminated sclerosis, and paralysis agitans. Nearly all of these affections have or may have mental disorders associated with them.

The mental disorders of multiple neuritis have been frequently recorded. Several years ago[1] I called attention to the concurrence of multiple neuritis with both myelitis and encephalitis, but I believe now that most of these cases with mental symptoms were instances of toxæmia rather than encephalic inflammation. Fisher[2] has reported a case of multiple neuritis in which loss of time and place were marked symptoms—a similar condition to that which occurs in drug-toxæmias. Since the recent series of influenzal epidemics first appeared I have seen many cases of acute and chronic mental disease directly or indirectly

[1] Mills: Journ. of Nerv. and Ment. Dis., 1887, vol. xiv. p. 209.
[2] Fisher: N. Y. Medical Journal, Feb. 13, 1892, vol. lv. p. 186.

its offspring, and often associated with neuritis. A few of these have been fatal cases of acute mania, during or following closely upon the heels of the influenzal attack, but many have been chronic and milder forms of insanity or of mental disorder, not rising to the dignity of true insanity. To most of these I have referred more at length elsewhere.[1]

The microbic origin of some forms of myelitis with which mental affections are occasionally associated is now generally admitted; and choreic insanities with mental manifestations equalling in violence the motor disorder are well known. Regis[2] has reported a case of choreic insanity with a form of delirium which seemed to be closely akin to that of alcoholic delirium. Dana[3] has reported an interesting case, with autopsy and bacteriological investigation, in which was found a micro-organism closely resembling the diplococcus lanceolatus, which, he believes, gives weight to the belief that in some cases at least a microbe produces the disease.

Marie,[4] in his great work on *Diseases of the Spinal Cord,* has expressed his profound conviction that the most efficient cause of disseminated sclerosis is infection, or rather *infections.* As early as 1884 he asserted in categorical fashion this relation of cause and effect, having collected twenty-five cases in which disseminated sclerosis had followed acute diseases; a certain number of these cases having been described in 1879 in a memoir of Kahler and Pick. Marie holds that in certain infectious maladies symptoms of central nervous affection may develop during convalescence, and later may amend and disappear, but sometimes sclerosis, and especially disseminated sclerosis, arises with greater or less rapidity. He does not contend that disseminated sclerosis has its special microbe, but that this condition may appear in a crowd of infectious diseases which differ very much, one from the other; and that it is most frequently the result of one of the combined infections so frequent in the course of different infectious diseases. The infection is not so much due to a special microbe as it is to the localization of the infectious agencies in the nerve centres. If we accept the view of Marie regarding disseminated sclerosis, the same reasoning would lead us to believe that other forms of sclerosis and general paralysis of the insane—and perhaps neuro-systemic degenerations in general—are due to infection. Marie's[5] observations on the poliomyelitic origin of the lesions of the white medullary fasciculi in pellagra, general paralysis, and different combined scleroses, are of great importance in this connection.

[1] Mills: Trans. Phila. Co. Med. Soc., June 13, 1892, and Medical News, Jan. 30, 1892, p. 118.
[2] Regis: Journ. de Médecine de Bordeaux, July 20, 1890.
[3] Dana: Amer. Journ. Med. Sci., Jan., 1894, vol. cvii., No. 1, p. 31.
[4] Marie: Leçons sur les Maladies de la Moelle, 1892, pp. 140–142.
[5] Marie: La Sémaine Médicale, Jan. 13, 1894, p. 17.

Passing to the consideration of the results of combined clinical, pathological, and bacteriological investigations, the most valuable contribution which has thus far come from an association of clinical and laboratory work is an article entitled "A Contribution to the Etiology and Pathogenesis of Acute Delirium," by Dr. Carlo Rasori,[1] assistant physician to the Hospital for the Insane, at Bologna, the work emanating from Tizzoni's Laboratory for General Pathology.

As Rasori's paper is of great importance to our subject, and as it has not received the attention it deserves from the medical journals of this country, I shall refer in detail to its results.

Rasori describes in detail a case of acute delirium, with autopsy and the results of a careful bacteriological examination. At the outset he defines what he means by acute delirium, referring to the published work on this subject of Prof. Bianchi,[2] who has compiled the literature of the subject. A study of Bianchi's article shows, according to Rasori, that while authors agree upon the clinical picture and anatomico-pathological findings, their opinions with reference to the etiology and pathogenesis are often different and contradictory, and Rasori believes these differences are largely due to confounding different disorders and to the existence of transition forms, the most varying types of insanity having clinical episodes which sometimes give the picture of acute delirium. Acute delirium, as accepted by Rasori, is based upon Bianchi's descriptive definition—a general affection of the brain cortex which leads to a rapidly increasing and soon culminating dissolution of the psychical personality; with varying but severe disturbances of the senses and active excited movements; with quiet periods almost to the absence of consciousness; with intermissions of calmness; with convulsions, fever, early emaciation, rapid coma, and usually a fatal termination in from one to three weeks.

Rasori's patient was a woman, forty-five years old, without previous history of any moment. Her attack came on with persistent headache. She became confused and excited, talkative and incoherent, with a tendency to purposeless actions and to destructiveness, and refusal to take food. Her face was congested. She became noisier and more confused, consciousness was much disturbed, and she seemed to be the victim of terrible visual and aural hallucinations. Both pupils were sluggish and large, the right a little larger than the left. She had no fever, but she grew rapidly worse, developing opisthotonus, with clonic spasms of the facial muscles; noisy respiration, difficult deglutition, retention of urine, and rapid symptoms of exhaustion. Her temperature at the beginning was 38.5° C. On the evening before her death it reached 39.6° C. She died two weeks after the first appearance of the mental symptoms.

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[1] Centralblatt für Bakteriologie und Parasitenkunde, October 20, 1893, Bd. xiv., No. 16, Jena, p. 509.

[2] Bianchi: Sull' Origine Infettiva di una forma di Delirio Acuto, per Prof. L. Bianchi e Dott. F. Piccinino (estratto degli Atti della R. Acad. Med.-chirurg. di Napoli, anno lxvii., Gennaio, Febbraio, N. S., No. 1). Napoli (Stab. Tipogr. A. Tocco, Cav. A. Tocco, S. Pietro a Maiella 31), 1893. Reference cited from Rasori's article, as I have not access to the publication of Bianchi.

The autopsy was conducted with the strictest antiseptic and bacteriological precautions. With a sterilized syringe fluid was removed from below the dura, and a part of it deposited in a sterilized tube of obliquely congealed agar, and these tubes were placed in a thermostat at about 35° C.

Marked congestion was present in the meninges and brain substance, also œdema and several hemorrhagic spots below the membranes. In the right temporal lobe the cortical substance was softened. The lungs were emphysematous, the lower lobes showing hypostasis and œdema, and an adhesive pleuritis on the left. The colon had areas of congestion.

Two inoculations with subdural fluid led to the development of the same micro-organisms, a small bacillus with rounded ends, three times as long as its width. Usually it appeared alone, but sometimes two or three were found hanging together by their ends. Besides the typical forms, others longer and either straight or twisted were present; these took the stain less readily. Rasori made numerous experiments and found that the micro-organism grew well in different culture media. His experiments with gelatin, bouillon, and agar cultures are given in detail. He was not able to say anything concerning the influence of physical or chemical agents upon the vitality of the micro-organism or the possibility of its development in amœbic conditions; he was only certain that its life was of short duration if the culture medium was not the proper one. He made a series of four inoculation experiments upon rabbits to establish the pathogenetic effect of the micro-organisms. The inoculations were made as follows: 1. Below the dura; 2. Below the skin; 3. Into the nose; and 4. A subcutaneous inoculation of a culture of blood agar obtained from the second experiment. Rigid antisepsis was employed.

The experiments demonstrated that the bacillus obtained from the subdural fluid of the patient grew and multiplied in the body of the rabbit, and produced a toxic substance which destroyed the animal, with symptoms of acute septicæmia, at a period varying from one and a half to six days.

The post-mortem findings of the animals were: Hyperæmia of the meninges, sub-pial hemorrhages, staining of the lungs, liver, and kidneys, and swelling of the spleen. Preparations were taken from the brain and spinal cord which showed, in addition to nervous elements and leucocytes, rich cultures of the kinds used in the inoculations.

"It would be premature," says Rasori, "to draw positive conclusions, from so small a number of experiments, about the special conditions which favor the natural infection, as well as about the most likely way permiting this micro-organism to enter the human organism, where it exerts its influence especially upon the central nervous system, as appears from the picture of this disease—which is usually fatal, according to the most prominent alienists. I reserve the privilege of completing in due time the investigations contained in this communication, and also of announcing the results of the histological observations which I shall make in the future."

In August, 1893, in consultation with Dr. Charles S. Potts and Dr. J. F. Berlet, of Philadelphia, I saw a case of acute delirious mania, a report of which has been made to the Philadelphia Neurological Society by Dr. Potts.[1] The patient, a professional man, thirty-three years of age, in the preceding June had been attacked with urticaria, lasting until August, when a carbuncle made its appearance on his upper lip. This was opened and curetted. For several days prior to the operation he had taken rather large quantities of whiskey and morphine; but these were stopped, and he did well for nine days, when he became violently delirious, with hallucinations, delusions, incoherence, great agitation and excitement. His temperature remained normal until three days after the attack, when it rose to 101° F., and continued to increase until three hours before death, when it reached 108.2°, at which time delirium gave place to coma. The autopsy, made seventeen hours after death, by Dr. J. W. McConnell, in the presence of Drs. Potts, Berlet, Klemm, and the writer, was practically negative. Cultures were made from the cerebro-spinal fluid by Dr. D. Braden Kyle, and demonstrated the presence of the so-called streptococcus lanceolatus, or pneumococcus of Fränkel and Weichselbaum, and also the staphylococcus pyogenes aureus and albus. Microscopical examination of the cortex showed perivascular exudation and leucocytes in the lymph-sheaths and periganglia spaces. Dr. Potts, in reporting the case, suggests that as the germs isolated were those usually found in meningitis, the lack of microscopic findings was probably due to the fact that the toxæmia was so violent as to cause the death of the patient before naked-eye appearances had time to develop.

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[1] Potts: Journal of Nervous and Mental Disease, May, 1894, N. S., vol. xix. p. 338.

Through the kindness of Dr. M. V. Ball, of Philadelphia—to whom I am indebted for assistance and valuable suggestions in the preparation of this paper—I am able to present the report of an unpublished case of acute delirium with autopsy, and the results of a careful bacteriological examination.

The patient, a German, fifty-five years old, with a negative previous history, except of gonorrhœa and occasional rheumatic attacks, had been confined in prison for nearly eighteen months. He was suddenly attacked with delirium, having previously been to all intents and purposes in the best of health. He had marked delusions with hallucinations, and believed that people were coming to attack him. In his frenzy he tore up the furniture of his cell, destroyed his own property, and threatened death to anyone who would enter his cell. It became necessary to overpower him, but this was done as carefully as possible; and he was seen by Dr. Ball an hour after he had quieted down. He recognized the doctor, said that he felt dizzy, and that he believed this was due to a fall from his carriage some years before. Every now and then he would stoop down as if to pick up something, apparently because of hallucinations of sight. His whole appearance was of one in a fit of alcoholic delirium, but he had not had any liquor for eighteen months. He was given a mixture of hyoscyamus and bromide, and next morning seemed to be in a state of unnatural gladness. He had no fever, ate his food, and made no complaints; but he had said to his keeper, "If they are going to take me out to hang me they had better do so before breakfast"—clearly indicating delusions of persecution. In the evening he was quiet, but the next morning he was found hanging to the door of his cell, having strangled himself with the band of his pantaloons. When found he had evidently been dead several hours. The autopsy revealed under the dura several fresh patches of exudation; the pia was glassy and covered with two or three spots of a greenish-white exudate; the ventricles did not contain an unusual amount of serum. Three small round cysts filled with a milkish-colored gelatinous fluid were found in the choroid plexus on each side. Cultures were obtained from the ventricle serum and from the contents of the cysts.

The following is an extract from Dr. Ball's bacteriological report:

"In both cases in two days a fine growth occurred along the needle-track in a gelatin-agar tube—a sparse whitish growth on the surface of the tube, not liquefying. The germ obtained was a very small bacterium arranged in twos and threes, resembling micrococci very much, but plainly larger in one diameter than in the other. Most curious was the growth or rather formation of needle-shaped crystals along the growth of the germ. The fine white, six-sided crystals arranged themselves in bundles and stars, giving a growth of most characteristic appearance. From the original growth many cultures have been obtained, giving rise to the same peculiarity. In gelatin alone, however, it has not been obtained, but in pure agar and in gelatin-agar there has been no difficulty. A chemist who made an examination of the crystals believes them to be a sulphate of some kind. I had an idea that it was a nitrite, but the reaction for nitric acid or ammonia was not obtained. The crystals can be plainly seen with the naked eye. What relation they bear to the growth is, of course, undeterminable without further study. The bacillus of lactic acid is the only germ on record which gives rise to crystals along its culture."[1]

I am indebted to Dr. James R. Hunt, interne of the Hospital of the University of Pennsylvania, for the notes of another unpublished case of considerable interest. The patient was under the care of Dr. John Ashhurst, Jr., in the surgical wards of the University Hospital, who has kindly permitted me to refer to the case in this connection.

The patient was a German laborer, twenty-six years of age, who presented a history of obscure renal disease extending over a period of six years. A distinct resistance was felt in the region of the right kidney, which was quite tender on pressure. The urine contained numerous pus-cells, but no blood and no crystals. An exploratory operation was performed.

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[1] The preparations and procedures necessary for a bacteriological examination of the brain have been kindly summarized for me by Dr. Ball. The materials necessary to be at hand are a platinum needle, clean scissors, three nutrient agar tubes, three nutrient gelatin tubes, three nutrient blood-serum tubes, three nutrient bouillon tubes, a one per cent. sublimate solution, and an alcohol lamp or Bunsen burner.

The precautions necessary are: 1, that the tissue must not be exposed longer than absolutely necessary; 2, the instruments and needles must be passed through flame before touching the tissue; 3, the tissue must be at once conveyed to the nutrient or medium, and in doing this every contamination must be avoided—the cotton plugs, for instance, when removed from the tubes must be singed before they are taken out, and before they are replaced; 4, if the nutrient material is fresh, one tube of each kind must be kept for control experiments; 5, have labels on the tubes so that they can be marked at once.

After the calvarium has been removed, wash the dura with the sublimate solution, then, with the scissors—which have been sterilized in the flame—lift off a small portion of the dura, and if any subdural fluid is present, with a sterilized ear-spoon, such as in ordinary use, obtain a few drops, and inoculate at once one of the bouillon tubes with it. Without much exposure snip off a piece of the cortex with the sterilized scissors, and drop it into the second bouillon tube, and likewise obtain a small piece for one agar and one blood-serum tube. If there is any inflammatory exudate, dip the sterilized platinum needle into it, and then quickly inoculate a gelatin tube by thrusting the needle into the gelatin and withdrawing it. A stroke culture can be obtained by smearing the top of the agar in one of the tubes with the infected needle. Open the ventricles carefully with a sterilized knife or scissors, and with the platinum needle looped, or with the ear-spoon, obtain a few drops for the inoculation of the third bouillon tube and one blood-serum tube. The other tubes can be reserved for different portions of the cerebrum.

After the tubes have been inoculated, place two bouillon and two agar and two blood-serum tubes in the inoculating-oven at 35° C., and watch developments. The other bouillon tube is left in the room at ordinary temperature, likewise with the gelatin and the other agar and blood-serum tubes. If a distinct microbe is determined, its nature must be studied by experiments on animals.

A needle was thrust into the kidney substance in various directions in search of a calculus, but with negative results. A large drainage-tube was placed in the wound, which was closed. The day following the operation the patient became unmanageable, tearing and displacing the dressings, and on one occasion, while unobserved, he tottered down the ward. Beginning a few hours after this, there was almost complete suppression of urine, lasting forty-eight hours; but under treatment the secretion was re-established for a period of twenty-four hours, which was followed again by almost complete suppression, which lasted until death. Examination of the dressings showed pus and urine. A urinary fistula was evidently present. The man was irrational immediately after the operation, and this state gradually merged into one of moderate delirium, which on the seventh day amounted to actual mania, this lasting until death, which occurred ten days after the operation. The autopsy was made by Dr. H. W. Cattell. The right kidney lay in a bed of foul-smelling somewhat greenish pus resembling tubercular sputum. On section the renal substance was found infiltrated with pus, with great destruction of its upper portion. The kidney was of the large white variety, and contained a large, rather friable calculus, a perfect mould of the pelvis, infundibuli, and calices. The right ureter was thickened, but otherwise normal; the left presented a hydronephrosis, and on closer examination a stone the size of a lima bean of medium size was found plugging it at the junction of its inner and middle third. Examination of the brain and meninges was negative, with the exception of a slight haziness of the pia and some turbidity of the fluid in the lateral ventricles.

Cultures made from the meninges were negative; but from the fluid found in the lateral ventricles a pure culture of the bacillus pyocyaneus was obtained. Cultures from the pus in and about the kidney contained yeast and pus organisms, but not the bacillus obtained from the ventricular fluid.

The toxæmias of pregnancy and the puerperal state which result in mental disorder cannot be passed by in a discussion of this subject; indeed, thoroughly studied, they might afford the best foundation upon which to build our discussion. Davis,[1] who has recently contributed a brief but valuable clinical paper on the toxæmia of pregnancy, believes that the mode of production of the toxine or poisonous waste which threatens pregnant women is not clearly explained; that while the usual metabolic processes account for a portion of the material present, a certain number of the cases point strongly to an acute inxtoxication due to the products of bacteria. In one of his cases in which marked toxæmia was present, the examination of the urine failed to reveal either casts, albumin, or marked deficiency in urea. Pronounced symptoms were present, as coronal and frontal headache and extreme restlessness and melancholia, greatly exceeding the usual timidity manifested by patients in the pregnant condition.

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[1] Davis: AMER. JOURN. OF THE MED. SCI., Feb., 1894, vol. cvii. p. 147.

Tuke and Woodhead[1] believe that in puerperal insanity a considerable proportion of cases is due to toxic influences, for although a woman may become insane during her puerperal period, her case need not be referable primarily to childbirth. "However, the violent delirious mania which sometimes develops within fifteen days after delivery has all the aspect of toxic influences. The sudden inception, delirious character, rapid development, inflammatory complications, and tendency to death are eminently suggestive of septic origin. Such cases seldom present themselves later than a fortnight after childbirth (the period during which septic changes go on in the uterus), and more frequently they occur within ten days."

Olhausen,[2] in five and a quarter years, observed psychoses following eclampsia eleven times in two hundred cases. They occur early, seldom later than from two to four days, and are marked by constancy of hallucinations, rapid afebrile course, and generally favorable termination. They are doubtlessly intoxication-psychoses, closely related to uræmic changes in the blood. He suggests the following classification: 1. Psychoses directly due to febrile puerperal processes (infection-psychoses). 2. Idiopathic psychoses without bodily or febrile disease (lactation, acute anæmia). 3. Intoxication-psychoses, following eclampsia, or, exceptionally, uræmia without eclampsia.

While the mental disorders of the puerperium, like many other of its disastrous affections, are usually dependent upon the attendant and the surroundings of the puerperal woman, auto-infection has been claimed as an explanation of those cases which occur when every precaution has been taken. This question has been subjected to bacteriological investigation, especially by Williams,[3] who believes that the term auto-infection is not well chosen. Numerous careful bacteriological investigations have shown that the vaginal secretions of pregnant women are of two kinds—normal and pathological. The bacillus of the normal secretion is non-pathogenic, and, on the whole, is rather inimical to pus-producing organisms. In 10 per cent. of the cases with pathological vaginal secretion Döderlein[4] found the streptococcus pyogenes, which was demonstrated by inoculation experiments to be pathogenic in more than one-half of the cases, and these observations have been confirmed by Williams. The bacteria of puerperal infection, as summarized by Williams, are the streptococcus pyogenes, the staphylococcus aureus and albus, the gonococcus, and the colon bacillus. He holds that it is also quite probable that some of the putrefactive organisms play an important part in what Matthew Duncan has designated as sapræmia.

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[1] Tuke and Woodhead: Tuke's Dict. Psych. Med., 1892, vol. ii. p. 911.

[2] Olhausen: Zeitschr. f. Geb., Bd. 21.

[3] Williams: AMER. JOURN. OF THE MED. SCI., July, 1893, vol. xvi. p 45.

[4] Döderlein: Das Scheidensekert und seine Bedeutung für das Puerperalfieber. Leipzig, 1892.

While, so far as I have been able to learn, no satisfactory bacteriological examination has been made in a case of puerperal mania, Kaltenbach[1] or rather Gerdes[2] under the direction of Kaltenbach, made an exact and exhaustive bacteriological examination of the organs of a woman who died of puerperal convulsions; and the results obtained in this investigation would have equal significance in the explanation of fatal puerperal mania. Cultures were made from the lungs, kidneys, liver, and the aortic blood, and in all cases a growth developed which consisted entirely of a pure culture of a very short, thick bacillus. Its culture showed certain characteristic peculiarities. Injections into mice proved rapidly fatal, clonic convulsions occurring in about an hour, followed by death in stupor from nine to twenty hours. Relatively large doses of morphine, administered previous to the injection of the culture, prevented the occurrence of convulsions and saved the life of the animals. This drug, however, only prevents the effect of the germ, and does not inhibit its multiplication in the body. The rat is quite refractory to this germ, needing large doses; rabbits, pigeons, and guinea-pigs are refractory. Gerdes suggests a very careful bacteriological examination of all fatal cases of puerperal eclampsia. In a later article, Gerdes[3] declares—1. That the eclampsia bacillus is the sole cause of puerperal eclampsia, and is found in no other disease, and there can be no eclampsia without its presence; and that the infection proceeds from the uterus, probably from an endometritis existing prior to conception. 2. That convulsions due to other causes, occurring during labor, are to be strictly separated, on the basis of the post-mortem appearances, from true puerperal eclampsia. 3. Eclampsia is a well-characterized disease, strictly limited anatomically. 4. The profound changes found in the organs of eclamptic patients post-mortem are not adequately explained by the demonstration of the presence of the specific germ in the body, but are probably due, directly or indirectly, to its toxines.

It must be noted, however, that several obstetricians and bacteriologists have reached different conclusions from Gerdes. Hofmeister, Hagler, and Döderlein agree in declaring that they have not been able to convince themselves that the bacillus found by Gerdes is the cause of eclampsia. Hergott made cultures from the organs in seven cases of eclampsia without results. From the urine he isolated a bacillus in five cases. This bacillus was not identical with that of Gerdes. It had some pathogenic action on pregnant rabbits, but Hergott believes that this is due to its action on the kidneys.[4]

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[1] Kaltenbach; Wiener med. Blaett., 1892, No. 21.

[2] Gerdes. Ibid, 1892.

[3] Gerdes: Deutsche med. Wochenschr., June 30, 1892, No. 26, p. 603.

[4] Wien. med. Wochenschr., 1893, No. 22. Cited in Rev. Insanity and Nerv. Dis., December, 1893, vol. iv. No. 2.

Conclusions may be drawn as follows:

1. Specific infection must be included among the causes of mental symptoms and diseases which precede, accompany, or follow febrile and other infectious disorders.
2. Much negative evidence can be adduced in favor of acute delirium or acute mania being due to toxæmia—such evidence as is afforded by autopsies which reveal neither gross nor histological lesions; and in these cases the toxæmia probably overwhelms the patient before the production of meningitis or other disease.
3. Analogies with nervous affections which are known or believed to be of microbic origin—such as multiple neuritis, myelitis, and chorea—favor the view that insanities with similar or related phenomena and lesions are also microbic in origin.
4. The evidence afforded by careful bacteriological investigation of cases of acute insanity is thus far meagre, and shows that various micro-organisms may induce the same or similar types of mental disease.
5. The mental disorders of pregnancy and the puerperal state are probably, in a considerable proportion of cases, toxæmic, without reference primarily to childbirth; but it cannot be regarded as proved that a bacillus of either eclampsia or puerperal mania is the sole cause of these affections.

A CONTRIBUTION TO THE LOCALIZATION OF THE MUSCULAR SENSE.

By Dr. M. Allen Starr,
and
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There has been some discussion in regard to the existence of a muscular sense, or sense of the position of the limbs as derived from sensations arising in the surface, joints, and muscles, which can serve as a guide to movement. It has been claimed by some that a perception of movement is an inherent power of the motor area. It has been held by others that a muscular sense is separate from the voluntary motor function, and that it has a different cortical localization.

Without entering fully into this discussion, we desire to record the following very interesting case, which seems to give conclusive proof that the muscular sense has a localization of its own entirely independent of the motor impulse. The case is quite comparable to an accurate physiological experiment upon the cortex of the brain, although, as will